Chapter 1
Introduction

1-1. Purpose and Scope

This manual provides guidance for the design and placement of beach stabilization structures, specifically groins, nearshore breakwaters, and submerged sills.

1-2. Applicability

This manual applies to major subordinate commands, districts, laboratories, and field operating activities (FOA) having responsibility for the design of civil works projects.

1-3. References

Required and related publications are listed in Appendix A.

1-4. Background

In highly developed beach communities, the consequences of previously ignored or unanticipated beach erosion may become costly enough to warrant using structural measures. Such measures may consist of seawalls, revetments, groins, bulkheads, breakwaters, and/or beach fills. Generally the "hard" structures require special siting considerations and an accompanying beach fill to mitigate adverse effects on adjacent beaches. Beach fills are often the preferred and sometimes the most cost-effective alternative. These "soft" structures include artificial beach berms and dunes accompanied by periodic beach nourishments, feeder beaches, or sand bypassing systems. Periodic or continuous replenishment of beach fills allows them to erode and adjust to the dynamic requirements of the ocean shore and prevent return of the damaging erosion processes to or beneath the landward development. Beach fills emulate nature, are aesthetically pleasing, contribute to recreation, and add needed beach material to the shore processes rather than simply redistributing available sand. An Engineer Manual on beach-fill design is in preparation at the US Army Engineer Waterways Experiment Station.

1-5. Discussion

a. Beach fills. Because beach fills are vulnerable to severe storms, they may be short-lived when a storm is experienced soon after the fill has been placed. This short existence is often viewed by the public as failure of the beach fill, even if the loss proves to be temporary. Little, if any, notice is given to the protection the fill provided to upland areas and the economic loss it may have prevented. Also, the sand may not necessarily have been lost, but may have been moved to an offshore bar. In some cases, the rising cost of sand placement is causing the economic viability of beach fills to decrease. In other cases, repeated beach fills have developed a public perception that beach fills and required periodic renourishments are wasteful. It is therefore politically and economically necessary to lengthen the interval between renourishments or rehabilitative beach fills, i.e., to increase the amount of time that placed sand remains on the beach. This increased longevity can be accomplished by the prudent design and placement of several types of beach stabilization structures. The design and placement of these structures, particularly groins, nearshore breakwaters, and submerged sills, is the subject of this Engineer Manual.

b. Protective and beach stabilization structures. A distinction is made between protective and beach stabilization structures. The purpose of the former is to protect inland development and to armor the shoreline against erosion; the purpose of the latter is to retard beach erosion, increase the longevity of a beach fill, and maintain a wide beach for damage reduction and recreation. Seawalls and revetments are shore protection structures whereas groins, nearshore breakwaters, and sills are beach stabilization structures.

1-6. Overview of Manual

The design of successful beach stabilization structures involves applying knowledge of the physical environment and coastal processes at a site to the selection of a type of structure, the preliminary design of that structure or structures, and the subsequent analysis and refinement of that design. The economic justification for beach stabilization structures is the savings realized by increasing the amount of time that nourishment sand remains on the beach within a project area. The cost of hard beach stabilization structures should be less than the beach nourishment savings realized. If, for example, including beach stabilization structures in a project increases the renourishment period from 3 to 6 years, the amortized savings accruing from the less frequent nourishment is available to build the structures.

a. Scope. Design of beach stabilization structures is complex. It requires analyses of the wave, current, and longshore transport environments and the coastal processes at a project site. It requires knowledge of the functional performance of the various shore stabilization schemes, the application of engineering judgment and experience to the design, and the structural design of a system that will withstand the marine environment and function as intended. Beach stabilization structure designs are site specific, and no single scheme is best for all situations; consequently, each design must be tailored to its specific objectives and site. This manual provides guidelines and design concepts but does not, in most cases, provide detailed design procedures. References to the source of detailed design procedures are cited where appropriate.

b. Chapter 2. Chapter 2 provides general design considerations for beach stabilization structures, alternative types of beach stabilization structures, the various types of construction, and the general data requirements for design including wave and water-level data, longshore sand transport data, and shoreline change data.

c. Chapter 3. Chapter 3 deals with the functional and structural design of groins and groin systems. Groin dimensions such as height, length, spacing, and permeability, and their effects on a groin's functional performance are discussed along with the use of physical and mathematical models to evaluate designs. Wave, current, and earth forces on groins are also discussed.

d. Chapter 4. Chapter 4 deals with nearshore breakwaters, artificial headlands, and submerged sills. Design objectives are outlined along with descriptions of single and multiple nearshore breakwaters, artificial headlands, and submerged sills. Design factors include selecting the desired shoreline configuration and the breakwater height, length, distance from shore, permeability, spacing, and type of construction that will achieve the desired effect. The effect of breakwaters on nearshore circulation, wave conditions in the breakwater's lee, longshore transport, and onshore-offshore transport are discussed.

e. Chapter 5. Chapter 5 deals with construction and postconstruction activities, specifically, construction records, inspections, and project monitoring. Monitoring data include: ground photography, aerial photography, inspection reports, beach and dune profile surveys, wave data, other environmental data, wave force data, and ecological and archeological data. Requirements of the Operations and Maintenance Manual that must be developed to assist local sponsors in properly operating beach stabilization projects are discussed. This manual is required under ER 1110-02-1407.

f. Appendixes. Appendix A is a list of references cited. Appendix B is a compilation of the advantages and disadvantages of the various types of beach stabilization systems. Groins, nearshore breakwaters, submerged sills, and alternative beach stabilization schemes are considered. Appendix C describes dimensional analysis related to groin design and provides an example application. Appendix D provides a description of the numerical shoreline change model GENESIS. Appendix E provides a dimensional analysis for breakwater and submerged sill design and provides an example application for a detached breakwater.